(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 September 2003 (18.09.2003)

PCT

(10) International Publication Number
WO 2003/077270 A3

(51) International Patent Classification[7]: H01J 1/62

(21) International Application Number:
PCT/US2003/006938

(22) International Filing Date: 6 March 2003 (06.03.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/094,426 8 March 2002 (08.03.2002) US

(71) Applicant and
(72) Inventor: **SUNG, Chien-Min** [US/—]; 4 Lane 32, Chung-Cheng Road, Tansui,, Taipei County, Taiwan Province 23911 (TW).

(74) Agents: **WESTERN, M., Wayne** et al.; Thorpe, North & Western, LLP, P.O. Box 1219, Sandy, UT 84091-1219 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

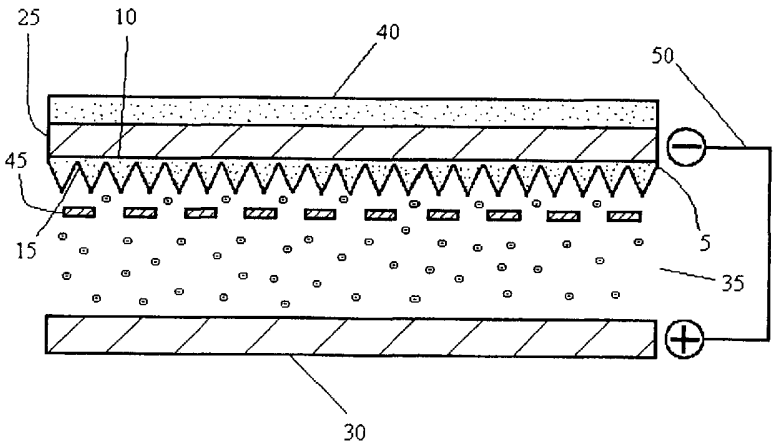
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

(88) Date of publication of the international search report:
12 February 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: AMORPHOUS DIAMOND MATERIALS AND ASSOCIATED METHODS FOR THE USE AND MANUFACTURE THEREOF



(57) Abstract: An amorphous diamond material (5) that is capable of emitting electrons in a vacuum upon the input of a sufficient amount of energy. The material may utilize both compositional and geometrical aspects in order to maximize electron output and minimize required energy input. In one aspect, the amorphous diamond material may include at least 90% carbon atoms with at least about 30% of such carbon atoms bonded in distorted tetrahedral configuration. Further, the material may be configured with an emission surface having an asperity height (20) of from about 10 to about 10,000 nanometers. A variety of energy types may be used separately or in combination to facilitate electron flow, such as thermal energy, light energy, and induced electric field energy. The amorphous diamond material may be incorporated into a variety of vacuum-type devices, such as switches, laser diodes, electrical generators, and cooling devices.

WO 2003/077270 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/06938

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H01J 1/62
US CL : 313/495

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 313/310,496,495,346r,355,270,309,336,351,352; 445/14,24,50,51; 438/20; 136/200,205; 257/77

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Database searched: EAST; terms searched: carbon, tetrahedral, amorphous diamond

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 6,064,137 A (COX) 16 May 2000 (16.05.2000), column 5, lines 32-36; column 10, lines 1-3 and 31-34; column 13, lines 56-63; column 9, lines 41-47	1, 3, 6-8, 11, 18, 21-23, 27, 29, 33, 37 --- 2, 10, 17, 34
A	US 6,064,137 A (COX) 16 May 2000 (16.05.2000)	4,5,14,15,16,19,20,23, 25,27,29,30,31,36
X --- Y	US 6,204,595 B1 (FALABELLA) 20 March 2001 (20.03.2001), column 1, line 27; column 2, lines 65-67; column 3, lines 35-37; column 4, lines 38-39	1, 3, 6, 7, 33, 37 --- 2, 11, 18, 21, 22, 26, 34
Y	US 5,562,781 A (INGRAM et al) 08 October 1996 (08.10.1996), column 5, lines 14-16; column 6, lines 3-4; column 7, lines 45-48; column 1, lines 12-15	9, 24, 28, 32, 35
Y	US 6,132,278 A (KANG et al) 17 October 2000 (17.10.2000), column 14, lines 49-60	12, 13

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
02 October 2003 (02.10.2003)

Date of mailing of the international search report
21 NOV 2003

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (703)305-3230

Authorized officer
Sharlene Leurig

Telephone No. (703)305-4745

Form PCT/ISA/210 (second sheet) (July 1998)